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An Innovative Approach for Various Grades Of Geo-Polymer Concrete With The Replacement Of River Sand With Robosand

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Abstract — One of the endeavors to create ecologically neighborly cement is to decrease the use of Portland concrete by utilizing by-item materials, for example, fly powder. It is realized that generation of one ton of Portland concrete records for around one ton of carbon dioxide discharged to the climate, as the consequence of de carbonation of limestone in the oven amid assembling of bond. A critical progress in the use of fly fiery debris in cement is the improvement of high volume fly powder (HVFA) solid, which mostly replaces the utilization of Portland bond in concrete(up to 60%), while keeping up brilliant mechanical properties with upgraded sturdiness execution. Another improvement is geo polymer, i.e. inorganic Alumino-silicates polymer blended from minerals of land cause or by-items materials, for example, fly cinder, rice husk slag and so on., that are rich in silicon (Si) and aluminum (Al). Fly cinder is inexhaustibly accessible around the world, and endeavors to use it in solid creation are of huge enthusiasm to the solid technologists and industry. GGBS (Ground Granulated Blast Slag) is a waste material produced in iron or slag ventures have huge effect on Strength and Durability of Geopolymer Concrete. This paper gives a short audit of the advancement of geopolymer cement. The variables that influence the generation of geopolymer cement, for example, source minerals, workability, curing time, and curing temperature are talked about in the paper. The potential utilization of geopolymer cement and the future difficulties are additionally specified. The Geo-polymers are involved alumina-silicate materials which totally replaces the Portland bond in cement. The alumina-silicate materials which are disintegrated in soluble initiated arrangement i.e., Sodium Hydroxide or Potassium Hydroxide which in this manner polymerizes into sub-atomic affixes and systems to make the solidified folio which are alluded as in natural polymer concretes.

The primary goal of this venture is to research the different evaluations of Geo-polymer concrete by supplanting the fine total with Robosand. The Mix outline methodology is analyzed with various evaluations i.e., (M-30, M-35, and M-40) for Geo-polymer concrete. The compressive quality and workability of the solid are contemplated for different evaluations of the Geo-polymer concrete.

Keywords — *Geopolymer Concrete, Fly Ash, Strength, Curing, Compressive strength, Split Tensile strength, Flexural strength, and Temperature effect.*

1. INTRODUCTION

Amid at the season of creation of concrete, carbon dioxide is discharged into environment. One ton creation of bond around discharge one ton of CO2 into the environment. By contemplating that we are utilizing fly fiery debris as a coupling material for cement alongside antacid arrangements, which is named as "Geo polymer Concrete". Thus of this we can diminish interest for bond and furthermore diminish the discharges of pollutants into the air which are discharging by concrete enterprises. That to fly slag is a side effect of which is gotten from warm power plant, and it is additionally the most bounteous mechanical waste in the earth. The utilization of geo polymer concrete essentially diminishes CO 2 outflow and decreases ecological contamination. Usage of regular stream sand is expanding step by step with an expanding of development exercises. It is turning into a rare material now a day. It is the second significant part in the solid blend. Since it is a characteristic item; it has natural and inorganic matter. Natural matter if show in sand makes void breaks in the wake of setting of solid which understudy the quality of material get diminish and the porousness of cement is likewise a matter on the off chance that we utilize such sand. There were many issues ascending on extraction of normal sand like reduction of underground water table which impacts on farming, impact on amphibian life, disintegration of stream banks and loss of water holding limit are the issue related with regular sand extraction. To conquer every one of these causes engineered man made sand called produce sand can likewise be utilized as a part of place of totals. Here in this examination produce sand is used set up of fine totals. Water is not included in the concoction response of Geopolymer cement and rather water is ousted amid curing and consequent drying. This is rather than the hydration responses that happen when Portland concrete is blended with water, which create

the essential hydration items calcium silicate hydrate and calcium hydroxide. This distinction significantly affects the mechanical and compound properties of the subsequent geopolymer concrete, and furthermore renders it more impervious to warmth, water entrance, alkali–aggregate reactivity, and different sorts of concoction assault. On account of geopolymers produced using fly fiery debris, the part of calcium in these frameworks is essential, since its nearness can bring about blaze setting and in this manner must be painstakingly controlled. The source material is blended with an actuating arrangement that gives the alkalinity (sodium hydroxide or potassium hydroxide are frequently utilized) expected to free the Si and Al and conceivably with an extra wellspring of silica (sodium silicate is most usually used).The temperature amid curing is vital, and relying on the source materials and initiating arrangement, warm regularly should be connected to encourage polymerization, albeit a few frameworks have been produced that are intended to be cured at room temperature.

2. NECESSITY OF GEOPOLYMER CONCRETE

Development is one of the quickly developing fields around the world. According to the present world insights, consistently around 260, 00, 00,000 Tons of Cement is required. This amount will be expanded by 25% inside a traverse of an additional 10 years. Since the Lime stone is the fundamental source material for the customary Portland bond an intense lack of limestone may come following 25 to 50 years. More over while delivering one ton of bond, roughly one ton of carbon di oxide will be transmitted to the air, which is a noteworthy risk for nature. Notwithstanding the above enormous amount of vitality is additionally required for the creation of concrete. Consequently it is most basic to locate an option cover. The Cement creation produced carbon di oxide, which contaminates the climate. The Thermal Industry creates a waste called flyash which is essentially dumped on the earth, involves larges regions. The waste water from the Chemical Industries is released into the ground which taints ground water. By creating Geopolymer Concrete all the previously mentioned issues might be explained by adjusting them. Squander Fly Ash from Thermal Industry + Waste water from Chemical Refineries = Geo polymer concrete. Since Geopolymer concrete doesn't utilize any bond, the generation of concrete might be diminished and subsequently the contamination of air by the discharge of carbon di oxide should likewise be limited.

Constituents of Geopolymer concrete:

Fly Ash- rich in Silica and Aluminium
Sodium Hydroxide or Potassium Hydroxide
Sodium Silicate or Potassium Silicate

Properties of Geopolymer Concrete:

The superior properties of Geopolymer concrete,
sets at room temperature
Non toxic, bleed free
long working life before stiffening
Impermeable
higher resistance to heat and resist all inorganic solvents
higher compressive strength

Compressive quality of Geopolymer cement is high contrasted with the customary Portland concrete
Concrete. Geopolymer concrete additionally demonstrated high early quality. The compressive quality of Geopolymer cement is around 1.5 circumstances more than that of the compressive quality with the common
Portland bond concrete, for a similar blend. Essentially the Geopolymer Concrete indicated great workability as of the standard Portland Cement Concrete.
Constraints: The followings are the impediments

conveying the base material fly powder to the required area
High cost for the basic arrangement
Safety chance related with the high alkalinity of the enacting arrangement.
Practical challenges in applying Steam curing/high temperature curing process
Significant research is continuous to create geopolymer frameworks that address these specialized obstacles.

3. LITERATURE SURVEY

[1] Bhikshma et al. (2010), investigated the flexural behavior of high strength manufactured sand concrete. The researchers observed that Workability of the M50 grade manufactured sand concrete observed to be 30% less compared to the conventional concrete, the compressive strength of M50 grade concrete with varying percentages of (0%, 25%, 50%, 75%,and 100%) manufactured concrete improved the strengths by 6.89%, 10.76%, 17.24%, 20.68%,respectively and the load carrying capacity and Moment carrying capacity of the RC beams of manufactured sand concrete obtained 3 to 12% higher when compared to conventional concrete.

[2] GANAPATHI NAIDU.P et al (2012) presented out a Study on strength properties of Geopolymer concrete with addition of GGBS. In this paper an attempt was made to study the strength properties of Geopolymer concrete using Low calcium fly ash replacing with slag in 5 different percentages. They obtained Compressive strength of geopolymer concrete increases with increase in percentage of

replacement of fly ash with GGBS was up to 28.57% of replacement of fly ash by GGBS, the setting was normal and fast setting was observed. They concluded maximum of 25% loss in compressive strength was observed when geopolymer exposed to a temperature of C for two hours.°500.

[3] Madheswaran C.K et.al (2013) studied the variation of strength for different grades of geo polymer concrete by varying the molarities of sodium hydroxide. Different molarities of NaOH (3M, 5M, and 7M) were taken to prepare different mixes and cured in the ambient temperature. GPC mix formulations with compressive strength ranging from 15 to 52 MPa had been developed. The specimens were tested for their compressive strength at the age of 7 and 28 days. The compressive strength of GPC increased with increasing concentration of NaOH.

[4] Yogendra O. Patil et al (2013) carried out an experimental study using GGBS as partial replacement of OPC in cement concrete Experiment were made to study the compressive and flexural strength of concrete containing various % of GGBS at the age of 7, 28 and 90 days. They concluded that Increase in % of GGBS result in decrease in strength of concrete. The Optimum replacement of OPC by GGBS was 20%.

[5] Mohemed aquib javeed et al (2015) a carried out Studies to find out the optimum level of sustainable Geopolymer concrete with combination of manufactured sand and pond ash as a fine aggregate material replacing conventional natural river sand and using ambient curing for its strength development. It was confirmed that 60% of m-sand and 40% of pond ash as a replacement to natural sand was optimum amount in order to get a favourable strength.

4. RELATED WORK

Geo-polymer binder:

The reaction of Fly Ash with an aqueous solution containing Sodium Hydroxide and Sodium Silicate in their mass ratio, results in a material with three dimensional polymeric chain and ring structure consisting of Si-O-Al-O bonds. This material is called as Geo-polymer binder.

Fine aggregate (River sand replaces with Robo sand):

The aggregate which is passing through 4.75 mm sieve is known as fine aggregate.

It is generally seen that river sands are fast disappearing from river beds due to over exploitation. This has led to a series of research efforts and soon enough with a substitute that served equally well and much better than the river sand.

Robosand was used as replacement of fine aggregate. Robosand is a product of crushed stone, here the stones are crushed into smaller granular size of river sand granules and washed to remove the fine rock dust to enhance the quality as per IS: 2386-1975.

Coarse aggregate:

The particles which are greater than 4.75mm are considered as coarse aggregates. We are using 12.5mm size of aggregates.

Water:

Water is not involved in the chemical reaction of geo polymer concrete and instead water is expelled during curing and subsequent drying. Only water can be used in preparation of alkaline activator solutions. It can be considered only for the mixing of the geo polymer concrete.

Parameters considered for mix proportioning of geo polymer concrete:

Geo polymer binder:

Low calcium class F (ASTM CLASS F) fly ash is used.

The concentration of alkaline activator solution is 12M.

For 12M, 12*40=480 Grams of sodium hydroxide dissolved in 1000ml of water.

Solution to fly ash ratio=0.35.

Sodium hydroxide to sodium silicate ratio=1:2.5

Robosand: The following table represents the properties of Robosand.

Properties	***Observations***
Fineness modulus	*2.52*
Specific gravity	*2.76*
Bulk density	*1688 kg/m^3*

Coarse aggregate: The following table represents the properties of coarse aggregates.

Properties	***Observations***
Fineness modulus	*6.83*
Specific gravity	*2.61*
Bulk density	*1530 kg/m^3*

Preparation of Geo polymer Concrete Mixes:

Planning of geo polymer cement is like that of bond cement. The fly fiery debris, Robo sand, coarse totals were blended in dry state. At that point include arranged blend arrangement of sodium hydroxide and sodium silicate alongside additional water in view of water-to-geo polymer fastener proportion and blend

completely for 3–4 min in order to give homogeneous blend.

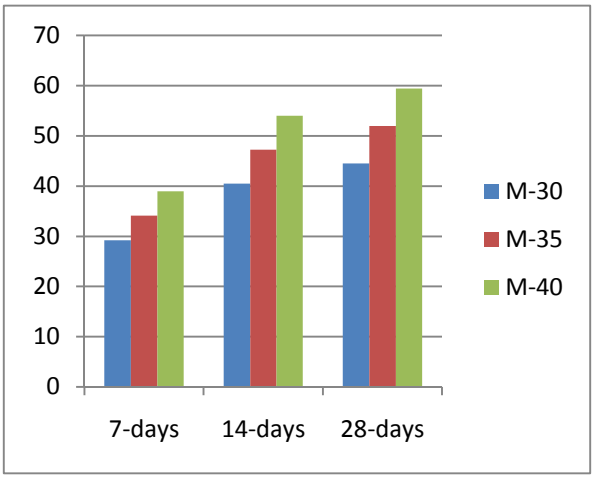
It was found that the new fly powder based geo polymer cement was gooey, Cohesive and dull in shading. In the wake of making the homogeneous blend, workability of Fresh geo polymer cement was measured by stream table mechanical assembly according to IS 5512-1983 and IS 1727-1967. Solid 3D shapes of side 150 mm& chambers of 300mm long&100 mm distance across are threw in three layers. Each layer is all around compacted by packing bar of measurement 16 mm. All cubes& barrels were place on table vibrator and vibrated for 2 min for legitimate compaction of cement. After compaction of cement, the top surface was leveled by utilizing trowel.

After 24 h of throwing, all 3D squares were de formed and afterward set in a broiler for warm curing (The curing is at 600c for 24hrs). To stay away from the sudden variety in temperature, the solid 3D squares were permitted to chill off up to room temperature in a broiler. Three 3D squares and chambers were thrown and tried for compressive strength& split elasticity for each curing period.

5. EXPERIMENTAL RESULTS

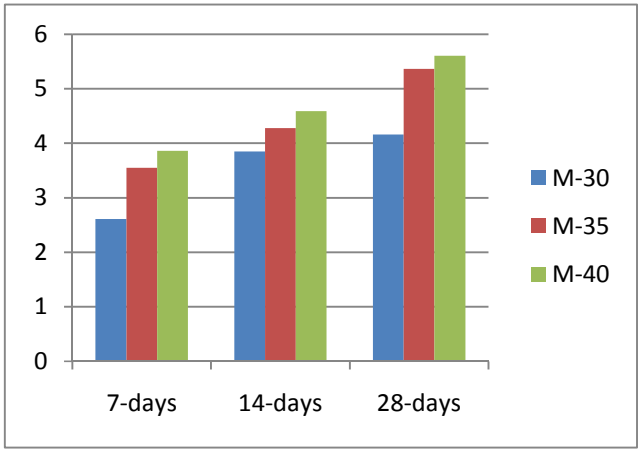
Test results of workability:

Graph for comparison of compressive strengths:



Graph represents the compressive strength for various grades.

Graph for comparison of split tensile strengths:



Graph represents the split tensile strength for various grades.

CONCLUSION

- Due to the production of geo polymer concrete, the cement production will reduce. So the production of carbon dioxide will reduce which will cause the green house effect.
- In the production of geo polymer binder, the materials like fly ash (waste material from thermal industries) & sodium hydroxide & sodium silicate (waste water from chemical refineries) can be utilized.
- The compressive strength is 1.5 times more than the ordinary concrete.
- With the use of Robo sand, the compressive strength is increases by 30 %(approx.)
- The geo polymer concrete is cheaper, eco-friendly, greater durability& having greater workability.

Properties	***M-30***	***M-35***	***M-40***
Workability in terms of flow (%)	29.17	44.15	61.61
Degree of workability	medium	medium	high
Passing ability(L-Box)	0.86	0.92	0.95

FUTURE SCOPE:

- Different concentrations of Sodium Hydroxide solution (8M, 10M, 14M & 16M) shall be used and the characteristics shall be studied.
- In order to study the use of Geo polymer Concrete as high strength concrete for pre stressed concrete structures (M-50 grade).
- Different percentages of robo sand shall be used and the characteristics shall be studied.

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